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ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN LAKE SUPERIOR PRECIPITATION

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INTRODUCTION

The discovery of chlorinated pesticdes (OCs) in remote regions of the world has demonstrated the problem of Long Range Transport of Atmospheric Pollutants on a global scale (Bidleman 1974). Within the Great Lakes Basin, organic contaminants found in the aquatic habitats in Siskiwit Lake of Lake Superior point to atmospheric deposition as a likely source (Swain 1978). Numerous studies have identified the presence of OCs and PCBs in rain and snow samples in the Great Lakes (Murphy 1977, Strachan 1979) and a report submitted to the International Joint Commision (IJC 1980) concluded that the Upper Great Lakes were especially susceptible to the impact of organic contaminants because of their huge volumes, long residence times, low productivities and low sedimentation rates. Reported estimates of atmospheric loadings of PCBs to Lake Superior and Michigan sggest that atmospheric deposition can account for greater than 80% of the total load (Murphy 1977, Eisenreich 1981).

Recognizing the serious threat of these chemicals to the ecological health of the Great Lakes, the International Joint Commission, in numerous reports (IJC 1980, 1985), have stressed the need for reliable measurements of airborne organic contaminants in the Great Lake Basin. Most of the available contaminant dada for atmospheric precipitation was obtained from intermittent collection of rain/snow

samples and was insufficient to provide the comprehensive database that was required. Consequently a monitoring strategy to utilize the existing precipitation network to monitor selected organic contaminants in wet deposition was proposed to the Great Lakes Environmental Adminstrators in 1984.

The sampling of organic compounds, relative to inorganic compounds, is more complex because of the different chemistries and extremely low concentrations involved. A common approach is to collect a large volume of rain/snow in a glass or stainless steel container, then concentrate the sample either in the field or laboratory using a solvent or solid absorbent . Murphy and Rzeutko (1977) employed a built-in glass-fibre filter to extract the sample at the time of collection, while Strachan and Huneault (1979) used XAD-2 resins to concentrate OCs and PCBs in rain. Pankow et al (1984) used Tenax-GC as a preconcentration medium for a range of polynuclear aromatic hydrocarbons. Kawamura (1983) extracted rain water with methylene chloride and identified 300 organic compounds. Few of the collectors cited in the literature are designed to operate in unattended remote locations and none of the samplers operates under freezing condition. A review of organic compounds in bulk and wet-only precipitaion by Mazurek (1986) concluded that there is substantive lack of consistent methodolgy for sample collection, preservation, storage, analysis, and data interpretation and research is needed to address these deficiencies.

Water Quality Branch of Environment Canada has developed a precipitation collector for year round collection of rain and snow samples for organic analysis. Two of these collectors have been located on the north shore of Lake Superior for over two years. Results from these samplers represent the first attmpt to collect time series data for organic contaminants in atmospheric precipitation. The following is a report on the data collected to-date.

SAMPLING METHODLOGY

The precipitation sampler used in this study is a modified version of the Strachan-Huneault sampler (1984). It consists of a stainless steel funnel, half a meter square, a movable lid, an electronic moisture sensor and a motor. The movement of the lid is controlled by the moisture sensor which is set on an arm about 0.5 M from the frame of the sampler. The underside of the funnel is lined with thermally-controlled heating cable to melt any snow or frozen precipitation. The funnel drains into a compartment which houses the sample container, a 4-litre amber glass bottle which contains about 200 ml of methylene chloride (Fig 1). The compartment is insulated with 1/2 inch of styrofoam and the temperature inside the compartment is maintained above freezing during winter months with two thermostatic controlled 50 watt heaters. A half inch flexible telfon tubing,

passes through a pinched clamp which is controlled by a solenoid valve, connects the funnel to a glass tube which extends into the methylene chloride layer at the bottom of the 4-L amber glass bottle. Upon draining into the bottle, the sample is thus forced through the solvent layer and, being lighter than the solvent, it rises to the top and lays over the solvent. During dry periods, the clamp pinches against the telfon tubing thus isolating the sample from the atmosphere. Another solenoid valve is fitted on the cap of the amber bottle for venting and drainage into another bottle in case of overflow. The opening and closing of the two valves synchronize with the movement of the lid. This feature caps the sample immediately after sample collection, minimizing dry deposition and sample loss due to evaporation of either solvent and sample.

Prior to deployment in the field, the funnel and tubing were cleaned with soap and water and then rinsed thoroughly with water, followed by reagent-grade acetone, and pet-ether. The amber glass bottle was tared and approximately 200 ml of pesticide grade methylene chloride was added to the bottle and placed inside the sampler. At the end of every two-week period, the sample bottle was removed and sent to Water Quality National Laboratory at Burlington for analysis. The sample was kept refrigerated at 4 C until analysed at which time the aqueous phase was seperated from the solvent and its volume measured. The aqueous phase was then extracted twice with fresh methylene chloride. The combined extracts were dried, and concentrated for cleanup and GC

analyisis following standard laboratory procedures (Analytical Methods Manual 1979). The organic compounds analysed included lindane, benzenehexachloride, dieldrin, aldrin, DDT and its residues, mirex, endosulfans, and polychlorinated biphyenyls. Field blanks (clean bottles with methylene chloride) were submitted along with regular samples. Analytical results from the blank samples and field samples showed no signs of contamination or interference.

SAMPLING SITES

The location of the two sampling sites is shown in Fig. 2. Both of these sites are faily remote and the samplers were installed in wide open surroundings. Sibley Provincial Park is located on the north shore of Lake superior about 45 KM east of Thunder bay. The sampler was installed on the property of a local resident at the tip of the peninsular at Silver Inlet, right on the shoreline of Lake Superior. Sampling at this site commenced in March of 1983 and has continued uninterrupted resulting in over 20 months of data. Turkey lake is located in the Algoma District near the Batchawana River, about 48 KM northwest of Sault-Ste-Marie. This site is the centre of an Experimental Watershed Study on the ecological effects of Acid Rain carried out the National Water Research Institute (NWRI). The sampler is installed on a sampling platform on top of a hill which also houses other meterological instruments and air and precipitation collectors.

RESULTS AND DISCUSSIONS

The sampling period for Sibley lasted 20 months from March 1983 to December 1984. A total of 39 samples were collected with no major disruption. However, , the sampler at Turkey Lake was a prototype model experienced some mechanical difficulties resulting in missing data points from July of 1983 to March of 1984. The total number of sample collected at Turkey Lake was 27.

The results are summarized in Table 1 and 2. The tables list the volume weighted mean concentrations of each parameter and the frequency of detection. The volume weighted mean is presented because of varying volume of precipitation collected during each sampling period and the number of samples which contained undetecteable amount of trace organics. The volume weight mean concentration is calculated by dividing the grand total of the amount measured by the grand total volume of precipitation during the entire sampling period. Values registering below the detection limits are assigned zeros.

The analytical results presented on Tables 3 to 6 represent the amount of organic compounds measured in a WHOLE sample. The instrument response for the compounds measured is 0.4 ng with the exception of

PCBs which is 9 ng. A number less than 0.4 ng confirmed the presence of the compound while a blank entry indicated that the compound was less than the instrument response.

HEXACHLOROCYCLOHEXANES (BHCs) : alpha-BHC (BHD) and gamma-BHC (LIN)

These two isomers of hexachloro-cyclohexane are widely found throughout the Great Lakes Basin (Strachan and Edwards 1984). Without exception, BHCs were found in every precipitation sample and had the highest concentration among the organochlorine pesticides.

Of the two iosmers, the BHD is the predominant form. In 1983, BHD was detected in 73% of the samples at an average volume weighted concentration of 5.8 ng/L (Table 1). In 1984, the dectection frequency was 97% and the mean weighted concentration was 25.05 ng/L, about 4 times higher than the 1983 avarage. A similar situation was observed with Lindane, the gamma-isomer. Frequency of detection for LIN went from 70% to 95% and the weighted mean concentration increased from 1.44 ng/L to 7.44 ng/L. The ratio of BHD to LIN was between 3 to 4. The data collected so far suggests that there was a significant increase in BHD and LIN in 1984 and that differences between Sibley and Turkey Lakes were small. Earlier data from Sibley (Strachan 1979) showed mean concentrations of 4.6 and 4.9 ng/L for BHD and LIN respectively, but the ratio of BHD to LIN was much smaller.

DIELDRIN AND ALDRIN

Like BHCs, dieldrin is also found throughout the environment (Strachan and Edwards 1984) although concentrations are lower than those of BHCs. Dieldrin is the photo-oxidation product of aldrin (Ross and Crosby 1975) and therefore, is more likely to be found in the environment than aldrin. Aldrin was only detected occassionally at low levels while dieldrin was found in 62% of the samples in 1984. Mean concentrations of dieldrin was measured at.06 ng/L in 1983 and 0.55 ng/L in 1984. This increase coincides with increases in BHCs and LIN. Earlier measurements of dielrin in rain by Strachan (1979) was 0.5 ng/L.

DDT RESIDUES and METHOXYCHLOR

Use of DDT has been banned since 1971, however, DDT and its residues are still being monitored in the environment. During the two years period, DDT and its residues were detected in only about 10% of the samples, and the concentrations were in the sub-nanogram range. Methoxychlor, a methoxy analog of DDT, was found in significant amounts (weighted mean concentration of 3.8 ng/L) at Turkey Lake in 1984.

POLYCHLORINATED BIPHENYLS (PCBs)

One of the latest environmental concerns is PCBs whose ubquitous presence and persistency have generated many studies on its transport, deposition, pathways, and impact on the environment. PCBs was shown to be present in 73% of the 1983 samples, and 43 % of 1984 samples. Annual weighted concentrations in 1983 and 1984 was 12.76 ng/L and 10.19 ng/L respectively. It should be noted that there was little difference between the values at Sibley and Turkey Lakes for both years. Earlier PCBs measurements in precipitation in Lake Superior were reported to be 24 ng/L (Strachan 1979). Based on a concentration of 11 ng/L and an annual precipitation of 750 cm per year, the estimated wet deposition of PCBs amounts to 680 Kg per year. Eisenreich (1981) estimated wet deposition of PCBs to be between 1500-3000 Kg per year.

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Chlordanes and endosulfans were detected occasionally at sub-nanogram levels. Mirex was not detected in any samples.

SPATIAL AND TEMPORAL VARIATION

Fig 3. graphically summarizes the two years of trace organics data for the two locations. The figure suggests that atmospheric deposition of BHCs in Sibley Park was similar to those in the Algoma District a distance of 360 KM to the southeast. Since there are no apparent

local sources of BHCs which are mainly used as agricultural fungicides. It is suggested that atmospheric concentration of BHCs over the region is relatively uniform. In the case of PCBs and methoxychlor, there seems to be north-south gradient with higher deposition of PCBs in the Algoma District which is much closer to the industrial states of North America. The year to year variation was not as large. Results reported by Murphy and Rzesuteko (1978) showed a similiar gradient with higher PCBs (65-138 ng/L) in the southern Lake Michigan basin and lower concentrations of 14-58 ng/L in Northern Lake Huron.

The differences in OCs between 1983 and 1984 was quite substantial. However, it is possible that the differences are artifacts or simply background variability. A larger network of precipitation station with a much longer sampling period is necessary to addresss the the temporal and spatial variation of contaminants in wet precipitation and the relative contribution of atmospheric pollutants to the Great Lakes.

SUMMARY AND CONCLUSIONS

The precipitation sampler described is capable of routinely collecting rain and snow samples for organic analysis. The combination of a large orifice sampler and in-situ extraction with methylene chloride has made it possible to quantify organochlorine pesticides and

polychlorinated biphenyls at the sub-nanogram per litre level.

Atmospheric precipitation in Lake Superior contains significant quantities of BHCs, PCBs, methoxychlor and dieldrin at volume weighted mean concentrations were 25.0, 10.2, 2.1 and 0.5 ng/L respectively.

It is recommended that a network of precipitation stations be established within the Great Lakes Regions to address the spatial and temporal variation and to assess the relative contributions of atmospheric pollutants to Great Lakes waters.

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TABLE 1 1983 VOLUME WEIGHTED MEAN CONCENTRATIONS OF OCs AND PCBS (ng/L)

	TURKEY (11)		SIBLEY (19)		BASIN	
	MEAN	# SAMPLE	MEAN	# SAMPLE	MEAN	% DETECTION
HXB	0.16	(8)	0.07	(8)	0.12	53
BHD	4.42	(6)	7.25	(16)	5.84	73
LIN	1.10	(6)	1.77	(15)	1.44	70
HEP		(0)	0.01	(3)	0.01	10
ALD	0.09	(1)	0.02	(1)	0.06	6
HEX	0.07	(2)	0.06	(4)	0.07	20
CHC	0.12	(1)	0.01	(1)	0.07	6
CHA		(0)	0.01	(1)	0.01	3
EMX	0.20	(2)	0.02	(2)	0.11	13
DDE	0.01	(1)	0.06	(4)	0.04	17
HEO	0.28	(2)	0.08	(4)	0.18	20
END	0.11	(4)	0.08	(8)	0.10	40
DDO		(0)		(0)		0
TDP		(0)	0.05	(2)	0.03	6
DDP	0.05	(2)	0.22	(1)	0.14	10
EMY	0.16	(2)	0.07	(4)	0.12	20
MIR		(0)		(0)		0
MEY	0.60	(5)	0.18	(5)	0.39	33
PCB	17.80	(11)	7.72	(11)	12.76	73

HXB hexachlorobenzene, BHD alpha-BHC, LIN gamma-BHC, HEP heptachlor, ALD aldrin, HEX heptachlor epoxide, CHC gamma-chlordane CHA alpha-chlordane, EMX alpha-endosulfan, DDE p,p"-DDE, HEO dieldrin END endrin, DDO o,p"-DDT, TDP p,p"-DDD, DDP p,p"-ddt EMY beta-endosulfan, MIR mirex, MEY methoxychlor, PCB total PCBs

TABLE 2 1984 VOLUME WEIGHTED MEAN CONCENTRATIONS OF OCs AND PCBs (ng/L)

	TURKEY LAKE (16)		SIBLEY (20)		BASIN	
	MEAN	# SAMPLE	MEAN	#SAMPLE	MEAN	% DETECTION
HXB	0.06	(11)	0.04	(7)	0.05	48
BHD	24.83	(16)	25.26	(20)	25.05	97
LIN	6.94	(16)	7.93	(19)	7.44	95
HEP		(0)		(0)	0.00	0
ALD	0.09	(0)	0.00	(5)	0.05	13
HEX	0.25	(10)	0.17	(11)	0.21	57
CHC	0.03	(1)	0.05	(4)	0.04	13
CHA	0.03	(2)	0.06	(3)	0.05	13
EMX	0.49	(7)	0.28	(7)	0.39	38
DDE	0.25	(4)		(0)	0.13	11
HEO	0.64	(10)	0.46	(13)	0.55	62
END	0.05	(4)	0.04	(3)	0.05	19
DDO		(0)	0.04	(2)	0.02	5
TDP		(0)	0.04	(1)	0.02	3
DDP		(0)	0.30	(1)	0.15	3
EMY	0.13	(4)	0.07	(7)	0.10	30
MIR		(0)		(0)	0.00	0
MEY	3.80	(8)	0.52	(5)	2.16	35
PCB	11.41	(9)	8.97	(7)	10.19	43

HXB hexachlorobenzene, BHD alpha-BHC, LIN gamma-BHC, HEP heptachlor, ALD aldrin, HEX heptachlor epoxide, CHC gamma-chlordane CHA alpha-chlordane, EMX alpha-endosulfan, DDE p,p"-DDE, HEO dieldrin END endrin, DDO o,p"-DDT, TDP p,p"-DDD, DDP p,p"-ddt EMY beta-endosulfan, MIR mirex, MEY methoxychlor, PCB total PCBs

TABLE 3.

ORGANICS IN ATMOSPHERIC DEPOSITION (ng) -- 1983

STATION	DATE	VOL	HXB	BHD	LIN	HEP	ALD	HEX	CHC	CHA	EMX	DDE	MED	END	TDP	DDP	EMY	MEY	PCB
Sibley	14/3	0.19	0.33																39.72
Sibley	6/4	3.69	2.19		1.54													1.69	78.92
Sibley	21/4	0.32		6.17	0.72											13.39			44.9
Sibley	1/5	3.83		32	6.9								3.11	0.54					66.18
Sibley	24/5	3.83	0.286	33.17	8.81						0.77							1.8	52.02
Sibley	1/6	7.66	0.98	54.58	31.97			1.41	0.4	0.316	0.73	0.79	0.53	0.25	1.82			4.72	80.83
Sibley	8/7	1.44		26.95	7.71														73.73
Sibley	1/8	7.17		2.927	0.889	0.13	0.99							1.096			2.67		6.26
Sibley	11/8	3.48		7.195	3.556	0.29						0.96							21.9
Sibley	1/9	4.11	0.12	3.51	2.5							0.375	0.79	0.97					5.67
Sibley	11/9	4.04	0.27	1.71		0.15		0.53						0.68			0.6	1.32	
Sibley	1/10	8.05	0.3	2.31	1.45								0.38	1.09			0.88	1.595	
Sibley	15/10	1.66		70.53	10.47														
Sibley	1/11	3.96		91.54	12.85			0.939							1.285				
Sibley	21/11	3.98		92.29	15.5							1.25							
Sibley	1/12	3.48		16.47	2.75			0.626											
COUNT		16	7	14	14	3	1	4	1	1	2	4	4	6	2	1	3	5	10
SUM		60.87	4.46	441.35	107.62	0.57	0.99	3.51	0.40	0.32	1.50	3.38	4.81	4.63	3.11	13.39	4.15	11.13	470.13
MEAN		3.80	0.64	31.53	7.69	0.19	0.99	0.88	0.40	0.32	0.75	0.84	1.20	0.77	1.55	13.39	1.38	2.23	47.01
STD		2.24	0.68	31.82	8.14	0.07		0.34			0.02	0.32	1.11	0.31	0.27		0.92	1.26	27.07
MAX		8.05	2.19	92.29	31.97	0.29	0.99	1.41	0.40	0.32	0.77	1.25	3.11	1.19	1.82	13.39	2.67	4.72	80.83
MIN		0.19	0.12	1.71	0.72	0.13	0.99	0.53	0.40	0.32	0.73	0.38	0.38	0.25	1.29	13.39	0.60	1.32	5.67
VMR		1.00	0.07	7.25	1.77	0.01	0.02	0.06	0.01	0.01	0.02	0.06	0.08	0.08	0.05	0.22	0.07	0.15	7.72

HXB hexachlorobenzene, BHD alpha-BHC, LIN beta BHC, HEP heptachlor
ALD aldrin, HEX heptachlor epoxide, CHC gamma chlordane,
CHA alpha-chlordane, EMX alpha-endosulhan, DDE p,p°-DDE, MED dieldrin
END endrin, DDD o,p°-DDT, TDP p,p-DDD, DDP p,p°-DDT,
EMY beta-endosufan, MIR mirex, MEY methoxychlor, PCB total PCBs.

TABLE 4.

ORGANICS IN ATMOSPHERIC DEPOSITION (ng) -- 1984

STATION	DATE	VOL	HXB	BHD	LIN	ALD	HEX	CHC	CHA	EMX	HED	END	DDD	TDP	DDP	EMY	MEY	PCB
SIBLEY	1/1	2.29		19.00	2.57													
SIBLEY	1/2	2.86		88.50	15.53													
SIBLEY	1/3	3.50	0.42	23.76	7.01		0.71			0.91	1.28						2.88	155.50
SIBLEY	1/4	4.08	0.43	130.59	8.61		0.48		2.08		1.71	0.92	1.60	2.72	19.14	0.65		
SIBLEY	1/5	4.11	0.57	168.34	105.74		1.43	1.36	0.84	8.93	4.26	0.91				0.65	7.69	59.55
SIBLEY	23/5	0.91	0.22	37.08	20.46		0.36				0.85						2.31	131.50
SIBLEY	1/6	12.18	0.11	420.50	211.08		5.57	0.84		4.59	13.14	0.47				0.48	20.25	156.77
SIBLEY	1/7	4.09		182.60	36.69		0.54	0.80	1.02	1.30	0.83					0.32		
SIBLEY	18/7	4.04		129.30	27.63		0.83	0.26		1.40	0.83							
SIBLEY	27/7	4.95		131.80	22.25													
SIBLEY	17/8	2.15	0.46	3.00	2.42													29.24
SIBLEY	1/9	4.06		117.86	14.99					0.93	0.33							
SIBLEY	11/9	4.07		48.15	8.98		0.42									0.31		
SIBLEY	25/9	0.02		0.53														
SIBLEY	1/10	4.04		82.63	16.38	0.19	0.61				1.27					1.38		
SIBLEY	21/10	0.14																
SIBLEY	1/11	4.06		5.42	2.96						3.48							43.30
SIBLEY	1/12	2.63	0.09	31.95	5.77						1.38		1.02			0.72		
COUNT		18	7	17	16	1	9	4	3	6	11	3	2	1	1	7	4	6
SUM		64.17	2.30	1621.01	509.07	0.19	10.95	3.26	3.94	18.06	29.36	2.30	2.62	2.72	19.14	4.51	33.13	575.86
STD		2.52	0.17	99.80	52.17		1.57	0.39	0.55	2.94	3.50	0.21	0.29			0.34	7.22	53.32
MAX		12.18	0.57	420.50	211.08	0.19	5.57	1.36	2.08	8.93	13.14	0.92	1.60	2.72	19.14	1.38	20.25	156.77
MIN		0.02	0.09	0.53	2.42	0.19	0.36	0.26	0.84	0.91	0.33	0.47	1.02	2.72	19.14	0.31	2.31	29.24
VWM		1.00	0.04	25.26	7.93	.00	0.17	0.05	0.06	0.28	0.46	0.04	0.04	0.04	0.30	0.07	0.52	8.97

HXB hexachlorobenzene, BHD alpha-BHC, LIN beta BHC, HEP heptachlor
ALD aldrin, HEX heptachlor epoxide, CHC gamma chlordane,
CHA alpha-chlordane, EMX alpha-endosulfan, DDE p,p'-DDE, HED dieldrin
END endrin, DDD o,p'-DDT, TDP p,p-DDD, DDP p,p'-DDT,
EMY beta-endosufan, MIR mirex, MEY methoxychlor, PCB total PCBs.

TABLE 5.

ORGANICS IN ATMOSPHERIC DEPOSITION -- 1983

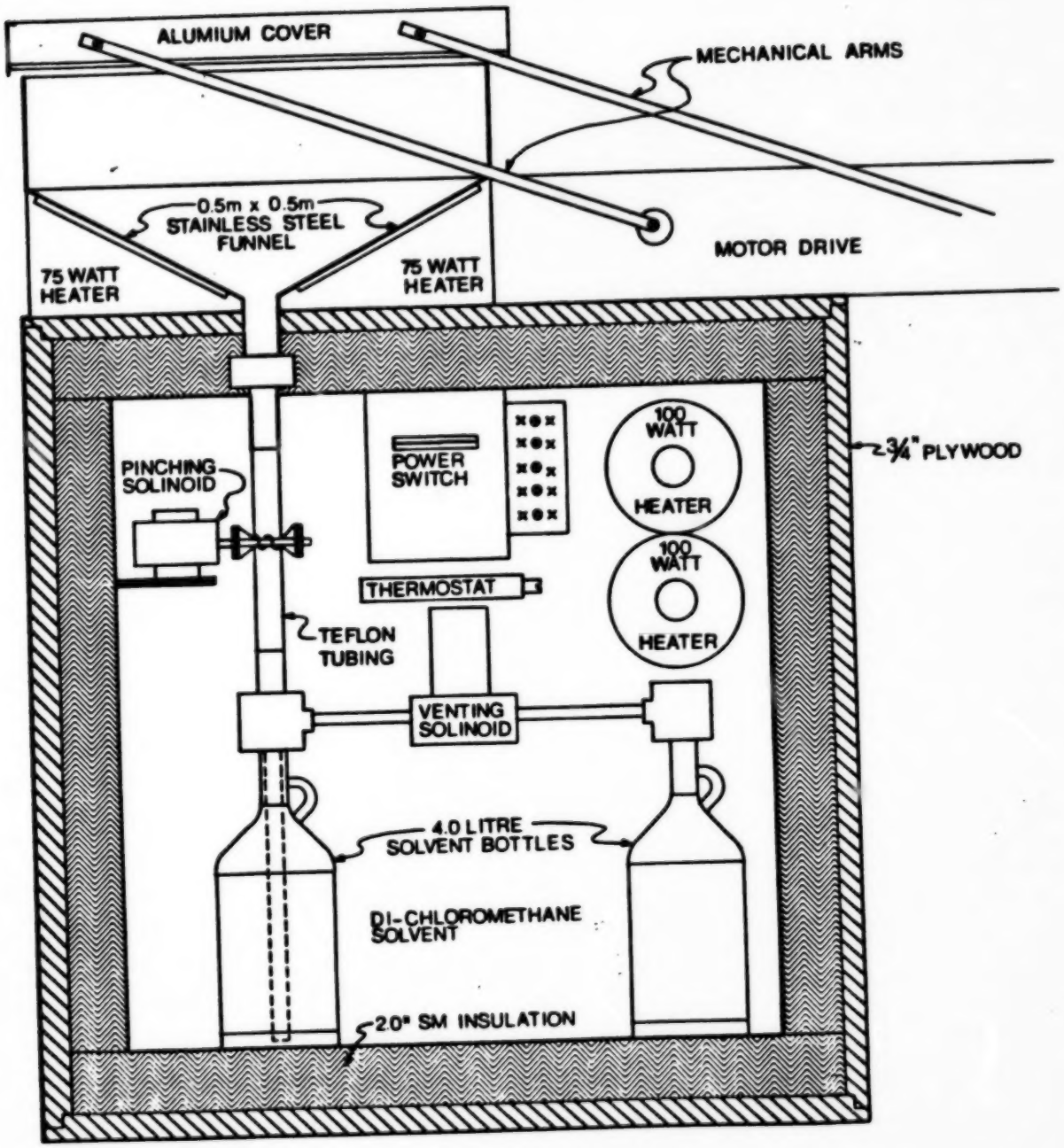
STATION	DATE	VOL	HXB	BHD	LIN	ALD	HEX	CHC	EMX	DDE	MED	END	DDP	EMY	MEY	PCB
Turkey	9/3	1.61	0.48	13.25	0.77								0.81			113.24
Turkey	22/3	2.050	0.47													53.59
Turkey	12/4	3.890	0.55	40			1.3	2.85	4.38		5.45	0.47			2.46	49.22
Turkey	16/4	0.960	0.27		0.48						1.22				1.09	21.22
Turkey	19/4	0.620	0.23	6.5	0.71		0.45					0.47	0.36			29.15
Turkey	3/5	3.730	0.88	35.33	15.71							0.5		1.42	3	65.58
Turkey	24/5	3.380	0.895	2.38	1.3							1.22		2.34	5.94	62.62
Turkey	7/6	0.041														10.75
Turkey	21/6	3.505	0.09	7.97	7.21				0.5	0.25					1.8	1.54
Turkey	5/7	0.011														13.1
Turkey	19/7	4.080				2.17										5.89
COUNT		11	8	6	6	1	2	1	2	1	2	4	2	2	5	11
SUM		23.87	3.865	105.43	26.18	2.17	1.75	2.85	4.88	0.25	6.67	2.66	1.17	3.76	14.29	425.29
STD		1.527	0.2729	14.620	5.5912	0.0000	0.425		1.94	0	2.115	0.3206	0.225	0.46	1.6686	32.256
MAX		4.08	0.895	40	15.71	2.17	1.3	2.85	4.38	0.25	5.45	1.22	0.81	2.34	5.94	113.24
MIN		0.011	0.09	2.38	0.48	2.17	0.45	2.85	0.5	0.25	1.22	0.47	0.36	1.42	1.09	1.54
VMP		1	0.1618	4.4155	1.0964	0.0908	0.0732	0.1193	0.2043	0.0104	0.2793	0.1114	0.0490	0.1574	0.5984	17.811

TABLE 6.

ORGANICS IN ATMOSPHERIC DEPOSITION (ng) -- 1984

STATION	DATE	VOL	HXB	BHC	LIN	HEX	CHC	CHA	EMX	DDE	HEO	END	EMY	MEY	PCB
Turkey	7/3	2.920	0.833	29	2										88.56
Turkey	20/3	0.755		1.16	0.76									1.74	78.4
Turkey	3/4	1.065		3.08	0.99										
Turkey	17/4	3.970	0.28	168.34	48.35	2.38	1.75	1.04	1.52	11.61	7.27	0.91	0.87	82.59	58.15
Turkey	8/5	1.880		3.34	2.25	0.8			1.29		1		0.48	6.96	
Turkey	22/5	2.960	0.39	134.66	97.5	1.4		0.75	16.32	0.59	3.33	0.47		21.13	112.9
Turkey	5/6	3.980	0.18	64.65	21.84	2.29			1.66		11.73	1.23			
Turkey	16/6	4.080	0.27	105	34.18									11.31	66.83
Turkey	3/7	4.020	0.15	115.9	24.05	0.84			1.73		1.8				36.89
Turkey	17/7	3.920	0.07	89.3	19.92	0.74			1.4		1.11				
Turkey	31/7	4.010	0.579	100	20.43									2.097	111.6
Turkey	14/8	4.110	0.256	17.89	4.469						1.398		2.092	72.1	
Turkey	28/8	3.980	0.17	69.23	16.97	1.505			1.72	0.43	2.44			1.71	
Turkey	11/9	3.945	0.07	110.99	18.44	1.23				0.29			3.34		
Turkey	25/9	3.930		172.98	31.27	0.89					1.73				29.3
Turkey	9/10	3.070		120.35	21.69	1.07					1.73				17.28
COUNT		16	11	16	16	10	1	2	7	4	10	3	4	8	9
SUM		52.60	3.25	1305.87	365.11	13.15	1.75	1.79	25.64	12.92	33.50	2.61	6.78	199.64	599.93
STD		1.08	0.22	55.45	23.26	0.57	0.00	0.15	5.17	4.84	3.29	0.31	1.12	30.97	32.61
MAX		4.11	0.83	172.98	97.50	2.38	1.75	1.04	16.32	11.61	11.73	1.23	3.34	82.59	112.90
MIN		0.76	0.07	1.16	0.76	0.74	1.75	0.75	1.29	0.29	1.00	0.47	0.48	1.71	17.28
VMM		1.00	0.06	24.83	6.94	0.25	0.03	0.03	0.49	0.25	0.64	0.05	0.13	3.80	11.41

HXB hexachlorobenzene, BHC alpha-BHC, LIN beta BHC, HEP heptachlor
ALD aldrin, HEX heptachlor epoxide, CHC gamma chlordane,
CHA alpha-chlordane, EMX alpha-endosulfan, DDE p,p'-DDE, HED dieldrin
END endrin, DDD o,p'-DDT, TDF p,p-DDD, DDF p,p'-DDT,
EMY beta-endosufan, MIR mirex, MEY methoxychlor, PCB total PCBs.


ALUMIUM COVER
MECHANICAL ARMS
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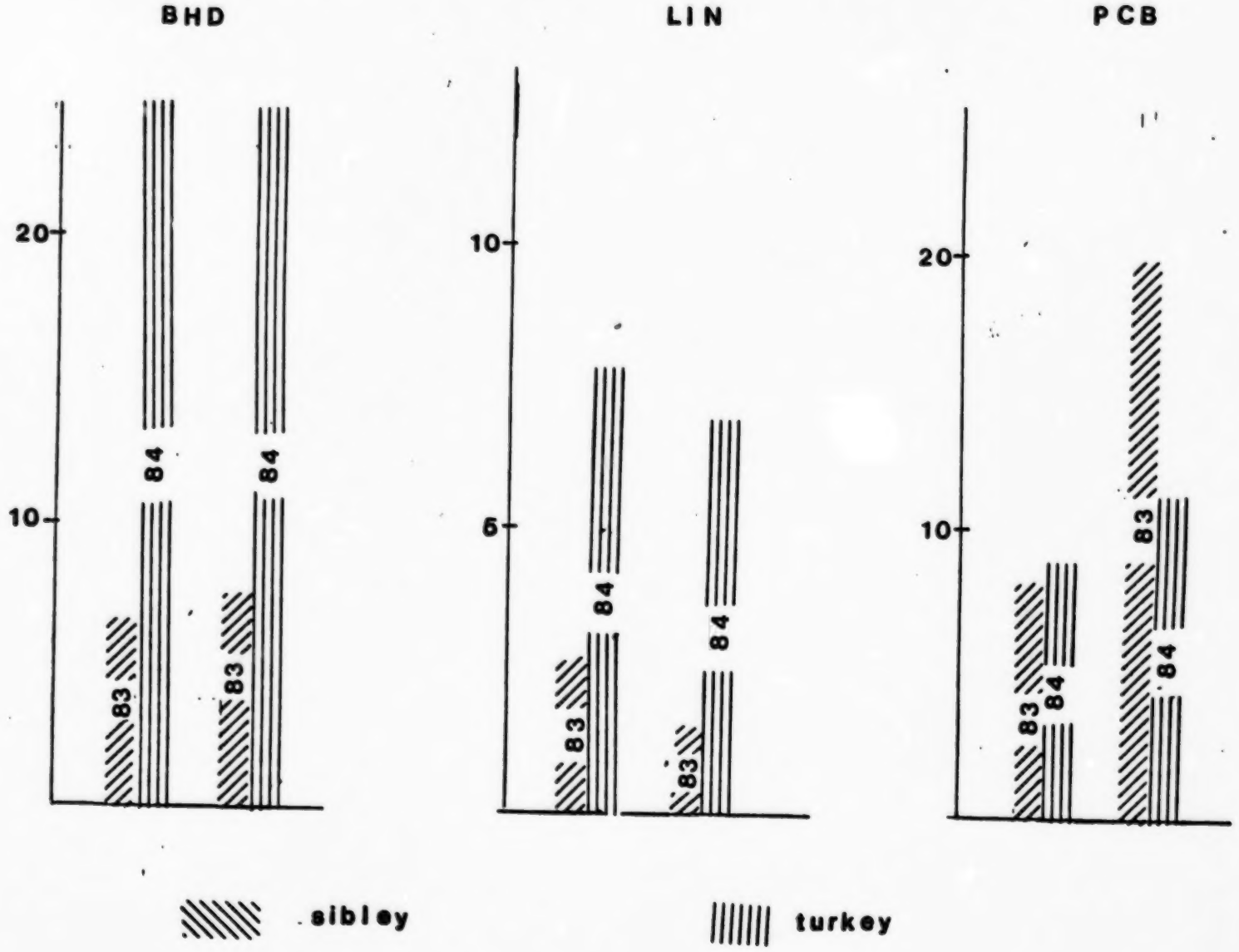
STAINLESS STEEL
FUNNEL
MOTOR DRIVE
75 WATT
HEATER
75 WATT
HEATER
PINCHING
SOLINOID
POWER
SWITCH
100
WATT
HEATER
3/4" PLYWOOD
100
WATT
HEATER
THERMOSTAT
TEFLON
TUBING
VENTING
SOLINOID
4.0 LITRE
SOLVENT BOTTLES
DI-CHLOROMETHANE
SOLVENT
2.0" SM INSULATION


BHD
LIN
PCB
20
10
10
5
20
10
83
84
83
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84
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84
sibley
turkey